

Claims

1. A volumetrically efficient electronic circuit module adapted for attachment to a motherboard, said module comprising:
 - 5 (a) a flexible, laminated, printed circuit substrate having first and second major surfaces;
 - (b) a plurality of integrated circuit dies mounted on the first major surface in spaced-apart rows, the dies in each row being overmolded with plastic leaving a space between adjacent rows;
 - 10 (c) a BGA disposed on the second major surface defined between two of said spaces;
 - (d) printed wiring conductors on one of said first and second major surfaces connecting selected ones of a plurality of terminal points in the BGA to said integrated circuit dies; and
 - 15 (e) said plastic overmolding being shaped along opposed side edges to permit folding of the printed circuit substrate along the spaces between adjacent rows such that only the second major surface is exposed and is in surrounding relation to the rows of overmolded integrated circuit dies.
- 20 2. The volumetrically efficient electronic circuit module as in claim 1 wherein the spaces between adjacent rows comprise preferential fold zones.
3. The volumetrically efficient electronic circuit module as in claim 1 and further including a mother board having a plurality of contacts arranged in a grid pattern corresponding to that of the BGA on the second major surface of the printed circuit substrate; and
 - 25 a plurality of solder balls joining the plurality of contacts individually to the BGA.

4. The volumetrically efficient electronic circuit module as in claim 2 wherein folding the printed circuit substrate along said preferential fold zones converts the electronic circuit module to a polyhedron.

5 5. The volumetrically efficient electronic circuit module as in claim 4 wherein the polyhedron is a rectangular parallelepiped.

10 6. The volumetrically efficient electronic circuit module as in claim 4 wherein the second major surface incorporates a conductive ground plane on a flexible insulating sheet, said conductive ground plane surrounding the plurality of integrated circuit dies when the printed circuit substrate is folded along the preferential fold zones.

15 7. The volumetrically efficient electronic circuit module as in claim 4 wherein the over molded plastic covering the dies in a first row include a protuberance and the over molded plastic covering the dies in a second row include a recess for receiving the protuberance when the printed circuit substrate is folded to form the rectangular parallelepiped.

20 8. A volumetrically efficient electronic circuit module adapted for attachment to a motherboard, said module comprising:

(a) a multi-layer, flexible, laminated, printed circuit substrate having first and second outer layers and at least one intermediate layer;

25 (b) a plurality of integrated circuit dies mounted on the first outer layer in spaced-apart rows, the dies in each row being overmolded with plastic leaving a space between adjacent rows;

(c) a plurality of terminal points disposed in a grid pattern on the intermediate layer on a surface defined between two of said spaces and exposed through a window formed in the second outer layer;

30 (d) printed wiring conductors on the intermediate layer connecting

selected ones of the plurality of terminal points in the grid pattern to said integrated circuit dies;

(e) said plastic overmolding being shaped along opposed side edges to permit folding of the printed circuit substrate along the spaces between adjacent rows such that only the second outer layer is exposed and is in surrounding relation to the rows of overmolded integrated circuit dies.

9. The volumetrically efficient electronic circuit module as in claim 8 wherein the spaces between adjacent rows comprise preferential fold zones.

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10. The volumetrically efficient electronic circuit module as in claim 8 and further including a mother board having a plurality of contacts arranged in a grid pattern corresponding to that of the plurality of terminal points on the second outer layer of the printed circuit substrate; and

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a plurality of solder balls joining the plurality of contacts individually to the plurality of terminal points.

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11. The volumetrically efficient electronic circuit module as in claim 9 wherein folding the printed circuit substrate along said preferential fold zones converts the electronic circuit module to a polyhedron.

12. The volumetrically efficient electronic circuit module as in claim 11 wherein the polyhedron is a rectangular parallelepiped.

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13. The volumetrically efficient electronic circuit module as in claim 11 wherein the second outer layer incorporates a conductive ground plane on a flexible insulating sheet, said conductive ground plane surrounding the plurality of integrated circuit dies when the printed circuit substrate is folded along the preferential fold zones.

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14. The volumetrically efficient electronic circuit module as in claim 11
wherein the over molded plastic covering the dies in a first row include a protuberance
and the over molded plastic covering the dies in a second row include a recess for
receiving the protuberance when the printed circuit substrate is folded to form the
5 rectangular parallelepiped.